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Lake Meredith, Crowley County, Colorado

National Eutrophication Survey, Corvallis, Oreg

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REPORT

ON

LAKE MEREDITH

CROWLEY COUNTY

COLORADO

EPA REGION VIII

WORKING PAPER No. 775

WITH THE COOPERATION OF THE

COLORADO DEPARTMENT OF HEALTH

AND THE

COLORADO NATIONAL GUARD

JULY, 1977

TECHNICAL REPORT DATA

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGEMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Colorado Department of Health for professional involvement, to the Colorado National Guard for conducting the tributary sampling phase of the Survey, and to those wastewater treatment plant operators who voluntarily provided effluent samples.

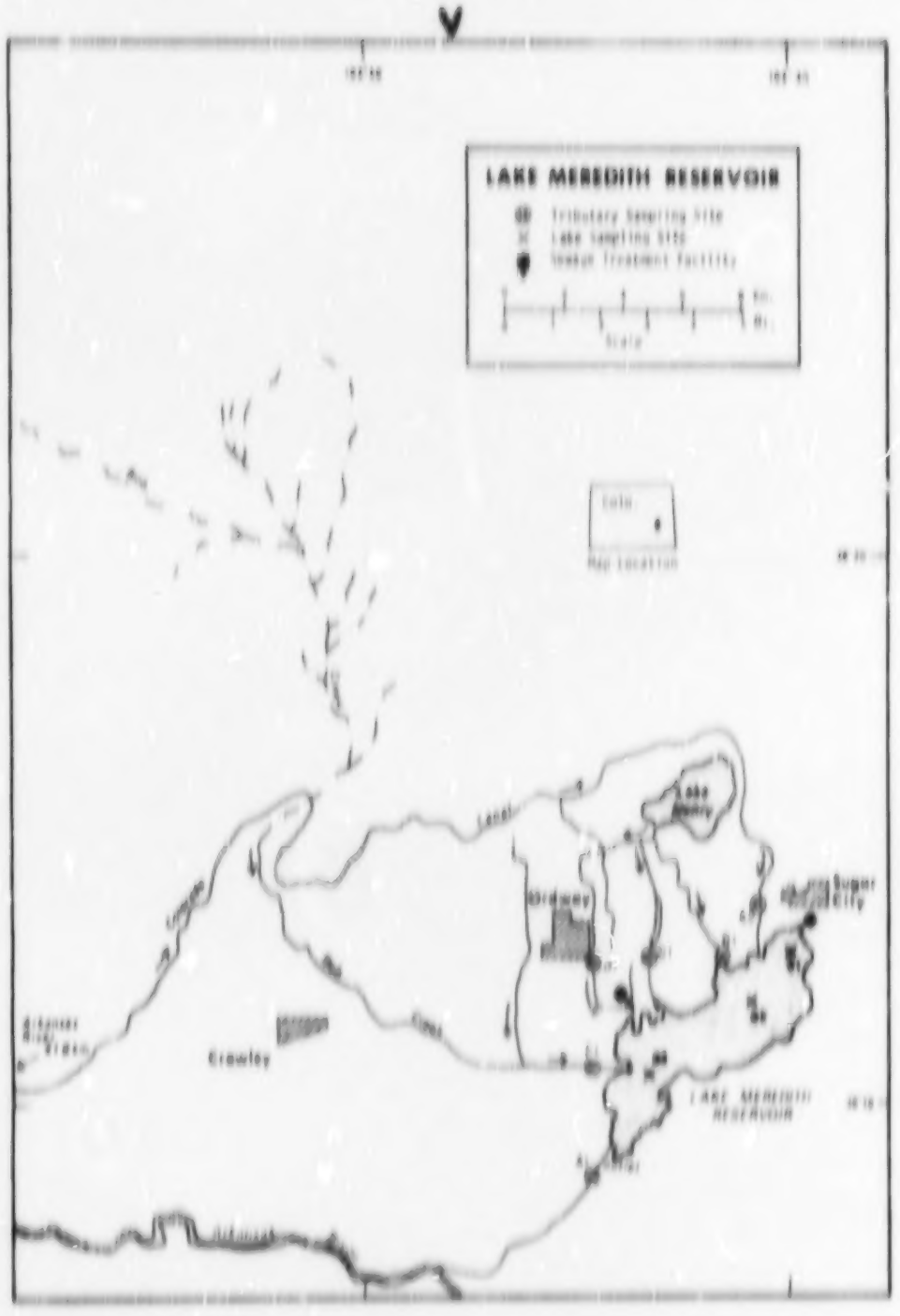
The staff of the Water Quality Control Division provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

Lt. Colonel Paul A. Parsons, the Deputy Adjutant General of Colorado, and Project Officer Colonel Hershel C. Yeargan, who directed the volunteer efforts of the Colorado National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY
STUDY LAKES AND RESERVOIRS

STATE OF COLORADO

NAME	COUNTY
Barker	Boulder
Barr	Adams
Blue Mesa	Boulder
Cherry Creek	Arapahoe
Cucharas	Huerfano
Dillon	Summit
Grand	Grand
Green Mountain	Summit
Holbrook	Otero
Meredith	Crowley
Milton	Weld
Navajo	Archuleta, CO; San Juan, Rio Arriba, NM
Shadow Mountain	Grand


LAKE MEREDITH RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Scale
State
Map Location
Lake Meredith
Fritch
Sanford
Borger
Sunray
Amarillo
Canyon
Dumas
Channel
Fritch
Crowley
LAKE MEREDITH
RESERVOIR

LAKE MEREDITH

STORET NO. 0810

I. INTRODUCTION

Accurate flow data could not be provided for Lake Meredith by the U.S. Geological Survey because water enters and leaves the lake through ungaged inlet and outlet canals. Therefore, this report primarily pertains to the lake sampling data. However, tributary and wastewater treatment plant samples were collected, and the results of the analyses are presented in Appendix D.

II. CONCLUSIONS

A. Trophic Condition:

Survey data indicate Lake Meredith is eutrophic. It ranked last in overall trophic quality when the 13 Colorado lakes and reservoirs sampled in 1975 were compared using a combination of six parameters*. Ten of the water bodies had less median total phosphorus and dissolved orthophosphorus, nine had less median inorganic nitrogen, 12 had less mean chlorophyll a, and ten had greater mean Secchi disc transparency.

Very high numbers of phytoplankton occurred in the August and October samples (see page 5).

B. Rate-Limiting Nutrient:

The algal assay results indicate the primary productivity of Lake Meredith was limited by nitrogen at the time the sample was collected (10/07/75). The lake data indicate nitrogen limitation on all sampling dates.

* See Appendix A.

III. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 13.03 kilometers^2.
2. Mean depth: 2.5 meters.
3. Maximum depth: 3.1 meters.
4. Volume: 32.575 x 10^6 m^3.

B. Precipitation*:

1. Year of sampling: 25.3 centimeters.
2. Mean annual: 31.8 centimeters.

† Table of metric conversions--Appendix B.
†† Anderson, 1974.
* See Working Paper No. 175, "...Survey Methods, 1973-1976".

IV. LAKE WATER QUALITY SUMMARY

Lake Meredith was sampled three times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, near-surface samples for physical and chemical parameters were collected from three stations on the lake (see map, page v). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the October visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis.

The sampling results are presented in full in Appendix C and are summarized in the following table.

[illegible]

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
05/06/75	1. Oscillatoria sp.	14,778
	2. Cylindrotheca (?) sp.	6,584
	3. Flagellates	3,438
	4. Aphanocapsa sp.	1,766
	5. Euglena sp.	1,171
	Other genera	4,609
	Total	32,336
08/22/75	1. Merismopedia sp.	86,437
	2. Oscillatoria sp.	63,972
	3. Anabaena sp.	11,477
	4. Anabaenopsis sp.	3,400
	5. Microcystis sp.	1,913
	Other genera	7,013
	Total	173,212
10/07/75	1. Oscillatoria sp.	932,406
	2. Anabaenopsis sp.	13,091
	3. Coelosphaerium sp.	2,036
	4. Cylindrotheca (?) sp.	1,455
	5. Aphanothece sp.	1,164
	Other genera	3,782
	Total	953,933

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (ug/l)
05/06/75	1	46.2
	2	32.8
	3	63.6
08/22/75	1	151.3
	2	151.3
	3	138.0
10/07/75	1	278.2
	2	271.3
	3	349.4

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.170	1.115	40.2
0.060 P	0.220	1.115	41.3
0.060 P - 1.0 N	0.220	2.115	67.1
1.0 N	0.170	2.115	63.9

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Lake Meredith was very high at the time the sample was collected (10/07/75). Also, the addition of nitrogen alone and in combination with phosphorus resulted in significant increases in yield which indicates the lake was nitrogen limited at that time. Note that the addition of phosphorus alone resulted in a yield not significantly greater than that of the control.

The lake data substantiate nitrogen limitation. The mean inorganic nitrogen to orthophosphorus ratios were 3 to 1 or less at all sampling times.

V. NUTRIENT SOURCES
(See Appendix D for data)

The operators of the Ordway and Sugar City wastewater treatment plants provided a number of effluent samples and some flow data. The results of the analyses of the samples are included in Appendix D.

A. Known municipal*:

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Ordway	1,250	stab. ponds	24.6	Lake Meredith
Sugar City	300	stab. pond	113.6**	ditch to Lake Meredith

B. Known industrial: None

C. Mean Nutrient Concentrations in Ungaged Streams:

Tributary	Mean Total P Conc. (mg/l)	Mean Total N Conc. (mg/l)
Lake Meredith outlet	0.120	5.406
Lake Meredith inlet	0.071	4.174
Unnamed ditch B-1	0.220	3.267
Unnamed ditch C-1	0.153	3.717
Unnamed ditch D-1	0.070	7.027
Bob Creek	0.053	4.912

* Treatment plant questionnaires.
** Design flow.

VI. LITERATURE REVIEWED

Anderson, R. Dennis, 1974. Personal communication (waterbody information and morphometry). CO Dept. of Health, Denver.

VII. APPENDICES

APPENDIX A

LAKE RANKINGS

[illegible]

[illegible]

LAKE CODE	LAKE NAME	[illegible] TOTAL *	[illegible] INDEX *	[illegible] SEC	[illegible] CALCIUM	[illegible]	[illegible]	[illegible]
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APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

PHYSICAL and CHEMICAL DATA

[redacted]

APPENDIX D

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

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